

CHAPTER 31

CATHODIC PROTECTION

31-1. Minimum maintenance activities for cathodic protection systems

The table located at the end of this chapter indicates items that must be performed to maintain systems and equipment at a minimum level of operational readiness. The listed minimum action items should be supplemented by manufacturer-recommended maintenance activities and procedures for specific pieces of equipment. Maintenance actions included in this chapter are summarized in table 31-1.

31-2. General maintenance procedures for cathodic protection systems

This section covers procedures for inspection and testing cathodic protection. Inspection frequencies may be increased as required based on observations and experience. Maintenance actions apply to both impressed current and galvanic (sacrificial anode) systems unless noted otherwise.

- a. Review maintenance records.* Personnel should review past maintenance records to find repair patterns. These records may point to certain components that should be closely inspected during performance of preventive maintenance.
- b. Review operator records.* Review operator records for items pertaining to the cathodic protection system.
- c. Rectifier inspection.* Perform a general inspection of the rectifier (impressed current systems only) as described below.
 - (1) Inspect to ensure that warning signs exist. Replace as required.
 - (2) Inspect enclosures for damage, unauthorized openings, and corrosion of metallic objects. Repair and paint as required.
 - (3) Inspect locking devices. Repair as required.
 - (4) Inspect air passages and remove any blockage.
 - (5) Inspect electrical connections for degradation. Repair as required.
 - (6) Inspect mounting for proper support. Repair as required.
 - (7) Inspect for loose connections and components. Tighten as required.
 - (8) Inspect connections and components for excessive corrosion. Take corrective measures as required.
 - (9) During operation, listen, investigate, and solve conditions for unusual noises.

- (10) During operation, inspect, investigate, and solve conditions causing unusual odors.
- d. *Test block inspection.* Inspect cathodic protection system test blocks as described below.
 - (1) Inspect to ensure that warning signs exist. Replace as required.
 - (2) Inspect enclosures for damage, unauthorized openings, and corrosion of metallic objects. Repair and paint as required.
 - (3) Inspect locking devices. Repair as required.
 - (4) Inspect electrical connections for degradation. Repair as required.
 - (5) Inspect mounting for proper support. Repair as required.
 - (6) Inspect for loose connections and components. Tighten as required.
 - (7) Inspect connections and components for corrosion. Take corrective measures as required.
- e. *Tighten connections.* All accessible cathodic protection connections should be cleaned and torqued to the proper design value.
- f. *Perform measurements.* Perform system measurements as described below.
 - (1) On systems with impressed current, record all meter readings and compare with past readings. Investigate as required.
 - (2) At each test station, measure and record structure-to-soil potentials. Compare with past readings and investigate as required.
 - (3) At each test station, measure and record current flow for each anode. Compare with past readings and investigate as required.
 - (4) At each test station, measure and record anode-to-soil resistivity for each anode. Compare with past readings and investigate as required.
 - (5) Perform other measurements and recordings as required at test stations relating to specific conditions such as potentials between protected and other structures, or to verify intentional short circuit bonds between structures exist as installed.
 - (6) Perform and record structure-to-soil potential measurements on each side of insulating fittings. If voltage readings are the same, investigate for possible shorts and take corrective action.

31-3. Trouble-shooting guide

Because cathodic protection systems are static systems and do not relate to any other active system, trouble conditions will not be noticed until measurements on the system are taken. Table 31-2 lists step-by-step procedures evaluating for common trouble situations.

Table 31-1. Cathodic protection

Cathodic Protection	
Action	Frequency
WARNING! MAINTENANCE PERSONNEL SHALL LOCKOUT/TAG EQUIPMENT TO ENSURE DE-ENERGIZATION DURING MAINTENANCE PROCEDURES.	
Review maintenance records	yr
Review operator records	yr
Inspect rectifier for the following:	
Inspect to ensure that warning signs exist. Replace as required.	yr
Inspect enclosures for damage, unauthorized openings, and corrosion of metallic objects. Repair and paint as required.	yr
Inspect locking devices. Repair as required.	yr
Inspect air passages and remove any blockage.	yr
Inspect electrical connections for degradation. Repair as required.	yr
Inspect mounting for proper support. Repair as required.	yr
Inspect for loose connections and components. Tighten as required.	yr
Inspect connections and components for excessive corrosion. Take corrective measures as required.	yr
During operation, listen, investigate, and solve conditions for unusual noises.	yr
During operation, inspect, investigate, and solve conditions causing unusual odors.	yr
Inspect test blocks for the following:	
Inspect to ensure that warning signs exist. Replace as required.	yr
Inspect enclosures for damage, unauthorized openings, and corrosion of metallic objects. Repair and paint as required.	yr
Inspect locking devices. Repair as required.	yr
Inspect electrical connections for degradation. Repair as required.	yr
Inspect mounting for proper support. Repair as required.	yr
Inspect for loose connections and components. Tighten as required.	yr
Inspect connections and components for corrosion. Take corrective measures as required.	yr
Tighten connections	yr

Table 31-1. Cathodic protection (continued)

Cathodic Protection	
<i>Action</i>	<i>Frequency</i>
<p style="text-align: center;">CAUTION!</p> <p style="text-align: center;">THE FOLLOWING MEASUREMENTS AND SUBSEQUENT EVALUATION SHOULD BE PERFORMED BY QUALIFIED PERSONNEL WHO MAY DIRECT ADDITIONAL TESTS.</p>	
Perform system measurements as follows:	
Record meter readings and compare with past readings (impressed current systems only).	yr
Measure structure-to-soil potentials at each test station and compare with past readings.	yr
Measure current flow for each anode and compare with past readings.	yr
Measure potentials between protected and other structures as required.	yr
Verify integrity of intentional short circuit bonds between structures.	yr
Measure structure-to-soil potentials on each side of insulation fittings.	yr

Table 31-2. Trouble analysis – cathodic protection systems

<i>Trouble</i>	<i>Probable Cause</i>	<i>Corrective Action</i>
Low structure-to-earth potential.	Depleted anode. High resistive conductor connection. Changes in soil condition causing higher soil resistivity. High anode-to-soil resistivity. Rectifier trouble.	Replace anode. Remake connection. Evaluate present cathodic protection system design. Decrease resistance of anode current limiting resistor. Tamp soil surrounding anode or chemically treat area. Investigate rectifier.
Positive structure-to-earth potential.	Rectifier trouble.	Investigate rectifier.
Low anode current flow.	Depleted anode. High resistive conductor connection. Changes in soil condition causing higher soil resistivity. High anode-to-soil resistivity.	Replace anode. Remake connection. Evaluate present cathodic protection system design. Decrease resistance of anode current limiting resistor. Tamp soil surrounding anode or chemically treat area.
No anode current flow.	Open circuit in anode conductor. Rectifier trouble.	Perform continuity test. Investigate rectifier.
Low differential voltage at insulating fitting.	Failure of insulating materials. Buildup of conductive material on inside of pipe. Fitting shorted out with incidental jumper.	Replace fitting. Remove material. Investigate and remove jumper.